to the course of practical events appearing in public affairs cannot afford to ignore their strongest opponent.

The evolution which is discovered everywhere in nature, to be properly demonstrated, must have its explanation set forth in three parts. First, it must be explained why there is change, for without change there can be no development; second, it must be shown by what agency change results in progress, for change to inferior or co-ordinate conditions is not evolution; and, third, what is the course of progress, for, if there is progress, it must be in some direction that can be determined, and thus science becomes prophetic.

Of the three departments of sociology, — namely, the causes of social change, the causes of social progress, and the course of social progress, — the work under consideration, as its name indicates, is devoted to but one, — the cause of social progress; though it incidentally discusses many of the subjects of evolution in other branches of science, and the author ultimately reaches the conclusion that education is the chief means to secure social progress, and thus secure human happiness.

SIEMENS' SOLAR ENERGY.

On the conservation of solar energy: a collection of papers and discussions. By C. WILLIAMS SIEMENS, F.R.S., D.C.L. London, *Macmillan & Co.*, 1883. 20+111 p. 8°.

THIS is a collection of the original paper read before the Royal society by Siemens, and the criticisms from Fitzgerald, Faye, Hirn, Archibald, and others, together with the replies of Siemens.

The theory, well summed up on p. 22, supposes that space is filled with aqueous vapor and carbon compounds; that these, at low pressures, are dissociated by the radiant energy of the sun; that the dissociated elements are drawn into the sun at its poles, unite, and generate heat sufficient to give a temperature of about 2,800° C.; and that the aqueous vapor and carbon compounds formed are again thrown off by centrifugal force at the sun's equator.

As evidence of the presence of carbon vapors in space, Siemens refers to the analyses of meteors, which in some cases have proved that hydrocarbons were a component of the meteoric mass, and again to the work of Abney and Langley on the absorption of the radiant energy of the sun.

The dissociation of vapors at low tensions is a point which seems to be well established. One of the earliest proofs is given in Prof. J. Willard Gibbs's paper on the equilibrium of heterogeneous substances.[1] He shows, that in a mixture of gases, as of oxygen, hydrogen, and vapor of water, in which the vapor is formed with a decrease in volume from that of the components, it is possible to assign a value to the tension such that the mixture may be in a state of dissipated energy; i.e., in such a condition that the energy of the system is a minimum for its entropy; and that any change in energy can be brought about only by work done by some outside system and in proportion to that outside work. In such a state, nothing of the nature of an explosion could be caused by an electric spark: the elements would cease to show the phenomenon of chemical affinity. Willard Gibbs writes, "It may, indeed, be true, that at ordinary temperatures, except when the quantity either of hydrogen or of oxygen is very small compared with the quantity of water, the state of dissipated energy is one of such extreme rarefaction as to lie entirely beyond our power of experimental verification." In the formula from which these results are deduced, the ratio occurs of the amounts of the components to that of the compound, these amounts being raised to small powers. This explains the qualification as to the amount of components which may exist in a free state.

This last condition may have an important bearing on the possibility of the truth of Siemens' theory; for, although Gibbs has shown that dissociation may occur in rarefied vapors, still the amount of the dissociation is limited unless the rarefaction be very great.

Some two or three years ago Professor Ogden Rood succeeded in getting experimental evidence of dissociation in rarefied gases at ordinary temperatures, but has never published his results.

Dr. Siemens gives, on p. 13, what evidence he early obtained of dissociation of gases in vacuum tubes under the influence of sunlight. What he has done since may be found from an account of his recent lecture at the Royal institution (*Nature*, May 3). Objections to the theory are well put by Fitzgerald when he asks (p. 41) "how the interplanetary gases near the sun acquire a sufficient radial velocity to prevent their becoming a dense atmosphere round him; why enormous atmospheres have not long ago become attached to the planets, notably to the moon; why the earth has not long ago been deluged when a constant stream of aqueous

[1] Proc. Conn. acad. sc., iii.

vapor, that would produce a rain of more than thirty inches per annum all over the earth, must annually pass out past the earth in order to supply fuel to be dissociated by the heat that annually passes the earth; and why we can see the stars, although most of the solar radiations are absorbed within some reasonable distance of the sun."

It can be hardly looked on as a strong answer to the first question, that "the gases, being for the most part hydrogen and hydrogen compounds, have a low specific gravity as compared with the denser gases forming the permanent solar atmosphere. On flashing into flame in the photosphere, their specific gravity would be vastly diminished, thus giving rise to a certain rebound action, which, coupled with their acquired onward motion and with the centrifugal impulse they receive by frictional contact with the lower atmosphere, constitutes them a surface-stream flowing from the polar to the equatorial regions, and thence into space." It is certainly hard to understand why the atmosphere of any member of the solar system should not be made up of the gases of interplanetary space in the same proportions in which they may exist in such space, if there is the free circulation called for by Siemens' theory.

Faye objects that the presence of such a resisting medium in space as the vapors is not to be accepted, with our present knowledge, and that the centrifugal force at the sun's equator is far too small for the action required.

Hirn, starting with the supposition that the sun's temperature is 20,000° C., writes, that, although the dissociated gases might unite in the chromosphere, they would, on passing down through the sun's atmosphere, be again dissociated, and absorb as much heat as they had given out on combining. To this, Siemens might have answered that the gases would again combine on passing off at the equator.

The discussion of the theory at the time of its first statement was most earnest; but, in spite of the ingenuity displayed in its elaboration, it as yet cannot be accepted as probable.

INSPIRED SCIENCE.

Eureka; or, The golden door ajar, the mysteries of the world mysteriously revealed. By ASA T. GREEN. Cincinnati, *Collins*, 1883. 141 p., portr., cuts. 16°.

THE publisher acts as editor of this book, interspersing his own chapters among the author's in an odd fashion. The florid periods of the one form a curious setting for the rough, ungrammatical language of the other.

The author has 'revelations' of a 'wonderful knowledge' which he obtained, partly in the woods, and partly in Oil City, and desires to impart them to scientific men. We will offer them a bit.

"If we would lay a telegraph-wire down down (*sic*) from every point of the earth, and of water, and all points telegraph at one time to a given point, the result would be to find that the atmosphere was going as fast as the earth, and the earth as fast as the atmosphere. *Thus you see* it is the atmosphere that carries the earth around. . . .

"Third reason why the earth is round; namely, because the mountains are up. If the earth was flat, the mountains would be just as liable to be down as up, but as the curvature of the earth is up, hence the mountains are up. . . .

"If sound travels by vibration, as science teaches, and science teaches that vibration creates heat, that if a cricket should stand on one end of a solid slabstone and rub his wings together, why is it that the vibration with the particles of stone does not completely melt the stone in ten minutes? I deny the hypothesis."

'Wonderful knowledge,' indeed!

WEEKLY SUMMARY OF THE PROGRESS OF SCIENCE.

MATHEMATICS.

Points of inflection. — Let $U = x^\alpha y^\beta z^\gamma + ku^\delta = 0$ be an equation in homogeneous co-ordinates; x, y, z, are the sides of the triangle of reference, and $u = ax + by + cz$; α, β, γ, δ, are integers such that $\alpha + \beta + \gamma = \delta$; a, b, c, are given quantities, and k a variable parameter. For $\alpha = \beta = \gamma = 1$, this equation gives a system of cubics having, as is well known, their points of inflection distributed by threes upon three right lines; viz., the three real points of inflection upon u, and the remaining six points, in threes, upon two imaginary lines.

The author, M. A. Legoux, proposes to consider the general case of curves of the order δ. The three sides of the triangle of reference are tangents to all the curves of the system in the points where these sides meet the line u. The order of contact is $\delta - 1$: if δ is even, the curve in the neighborhood of the point of contact lies on one side of the tangent; if δ is odd, the curve here cuts the tangent, giving a point of inflection of a higher order. M. Legoux shows that the proposed curves have imaginary points of inflection, which are distributed upon two conjugate imaginary right lines which are independent of the value of k. If δ is even, there are no other inflections; but, if δ is